N° 4350 A.D. 1915

Date of Application, 19th Mar., 1915.—Accepted, 16th Mar., 1916

COMPLETE SPECIFICATION.

Improvements in Rock Drills and like Machines.

We, GOGU CONSTANTINESCO, Engineer, of "Underwood", 8, Lichfield Road, Kew Gardens, London, W., and WALTER HADDON, Engineer, of 132, Salisbury Square, Fleet Street, London, E.C., do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to the application of methods of energy transmission by wave motion through liquids as described in the Specifications of Letters Patent No. 9029 of 1913 and No. 12,438 of 1914 to machines such as rock drills or analogous reciprocating machines.

In the said specifications reciprocating devices are shown which are operated by wave motion through liquids contained in two or more liquid columns connecting the generator with the machine operated.

The invention consists in a rock drill or like reciprocating apparatus operated at a distance from a power generator, by means of a series of periodic variations of pressure and volume travelling along a single liquid column.

The invention also consists in a rock drill or like reciprocating apparatus having springs co-operating with the reciprocating part, in such a manner as to form a condenser, adapted to counteract inertia effects at the period of reciprocation employed.

The invention further consists in combining with a rock drill operated as above described a condenser arranged to permit of a flow of liquid through it.

The invention also consists in the improved applications of transmission of power through liquid columns by wave motion hereinafter described.

The apparatus required according to this invention comprises a suitable prime mover, driving a pump, a single line of pipe connecting the pump to a drill constructed as hereinafter described, and if desired, a capacity consisting of a large vessel filled with liquid in connection with the pipe. For instance, in a plant adapted to drill a two-inch hole in hard rock, at the rate of about two inches a minute, there may be employed an electromotor of five horse-power, driving by a belt a pump having a piston of diameter $1\frac{1}{2}$ inches and a stroke of $2\frac{1}{2}$ inches. A bye-pass is provided by which the pump can be run up to speed without being placed in connection with the pipe leading to the drill. In proximity with the pump, there may be provided a large vessel with rigid walls, and of a capacity of 640 cubic inches, a suitable cock being provided by which the capacity can be cut off from the line as desired. The connection with the drill is made through one-inch wrought iron steam pipe, a length of 560 feet being used between the pump and the drill. The drill itself may be constructed as hereinafter described and illustrated.

The operation of such a plant is as follows:—The motor is started up, and the pump run up to speed pumping through the bye-pass, the speed of the motor being regulated to a given value, so that a given number of reciprocations of the pump takes place per minute. In the plant hereinafter described, 500 reciprocations per minute are employed, and the initial pressure of the liquid (which may be water) in the pump and the line may be 140 lbs. per square inch,

[*Price* 6*d*.]

The cock connecting the capacity to the line is now opened, and the bye-pass cock of the pump closed. The result is that the impulses given by the pump are communicated to the capacity and to the line, and each particle of liquid in the line will be set in reciprocating motion about a mean position. The whole mass of liquid in the line, however, will not reciprocate as a whole, but a series of periodic changes of pressure and volume will travel along the pipe. The liquid in the neighbourhood of the piston is alternately compressed and expanded, and the changes of pressure and volume travel along the line with substantially the velocity of sound in such a liquid column.

It will be seen that the working of the apparatus thus depends on the compressibility and elasticity of the liquid in the column, and that the power is transmitted by a true wave motion. In the particular instance under consideration the wave length would be about 500 feet. In the example given, the length of the wave is substantially the distance between the pump and the drill. Other distances, however, may be employed, suitable condensers, as described in the Specification of Letters Patent No. 12,438 of 1914, being employed to counteract the inertia of any length of the pipe beyond a multiple of the wave length.

A part of the apparatus hereinafter described comprises a condenser adapted to allow a limited flow of water through it, and the drills are constructed with apertures allowing the water to pass through them, so as to provide a stream for washing out the boring. This leak, however, has no function in the driving of the drill. When the impulses have been turned on to the line, as above described, in order to start the drill, it is merely necessary to turn the cock, admitting the pulsations to the end of the drill piston. The length of stroke of the drill will vary according to the extent to which this cock is opened.

Referring to the accompanying drawings—

Figure 1 shows a condenser arranged to allow for a continuous flow of liquid between the generator and receiver.

Figure 2 shows a combined condenser and rock drill.

Figure 3 is a section on the line X—X of Figure 2.

Figures 4 and 5 show a generator arranged to drive two drills mounted on suitable stands.

In the condenser illustrated in Figure 1, the condenser chamber *a* is provided at the two ends with an internally projecting cylindrical portion *b*, *b*, in which the ends of a hollow piston *c* slide. The hollow piston is closed at the two ends, and carries in the middle the projecting flange *d*, which allows clearance between its circumference and the walls of the chamber *a*. This flange serves as the abutment for the springs *e*, *e*, which normally keep the piston in the mean position, as shown in the top half of Figure 1. The lower half of Figure 1 shows the position at one end of the stroke. Ports *f*, *g*, are provided at the two ends of the hollow piston, and ports *h*, *h*, are provided through the internally projecting sleeves *b*. This sleeve is of a diameter larger than will fit the piston at its ends, as shown at *k*, *k*, and it will be seen that when the piston is at the end of its stroke, as illustrated in the lower half of Figure 1, there is a free passage through the condenser from the right hand side round the annulus between the piston and the enlarged portion of the chamber *k*, through the ports *f* and *g*, and around the flange *d*, through the port *h* at the left hand end, and so out through the other end of the chamber. It will be seen therefore that in this arrangement, at the end of the stroke in each direction there is free passage for liquid through the condenser.

Instead of providing special means for allowing a leak at the ends of the stroke, as above described, the pistons may be made a loose fit in the condenser chamber, so that there is a constant leakage from one end to the other.

In the rock drill illustrated in Figures 2 and 3, the fluid is admitted at 1, causing pulsations to take place in the cylinder 2. The working piston 3 is integral with the rifled extension 4, working in a ratchet device 5, 6. The member 5 carries a rifled bush, and suitable teeth 7, engaging with similar teeth

in the member 6. The member 6 is free to move longitudinally in the direction of the axis of the piston, but is prevented from revolving by longitudinal sliding keys 8. A spring 9 presses the part of the ratchet 6 against the part 5. When the rifled extension 4 moves longitudinally, it rotates the ratchet 5, but the form of the teeth 7 is such that in one direction they hold together, but not in the other. In this way on the down stroke of the piston the teeth slip, and the piston does not rotate; while on the up stroke of the piston they bind together, and the piston rotates. The piston rod is thus rotated slowly in one direction, in order to turn the cutting bit. The piston 3 is integral with the rod 10, sliding in the bush 11, which carries the chuck 12, holding the drill bit 13. The piston rod 10 and the drill bit are perforated in the centre by a passage 14 ending in a cross passage 15, communicating with an annular chamber 16 around the piston 3. In the forward end of the drill body 17 a stiff spring 18 is provided, held between the flange 19 and the bush 11. The bush 11 is free to slide longitudinally against the spring 18. The piston rod 10 carries a strong flange 20, supported by two springs 21, 22, forming a condenser with the piston working the drill, the spring 21 being stronger than the spring 22, in order to provide for the return stroke of the piston when working.

The operation of the instrument is as follows:—

The pulsations of the liquid entering by the cock 1 transmit motion to the piston rod and drill bits, the inertia of these parts being conveniently balanced by the condenser formed by the springs 21, 22, and the piston 10, in the manner explained in the Specification of Letters Patent No. 12,438 of 1914. The cutting of the rock is effected by the percussive movement applied to the bit 13, and the rotation is effected by the ratchet 5, 6, as above described. A leakage occurs between the piston 3 and the cylinder walls 17, and through the annular space 16 and the passage 14 to the end of the drill bit. If water is used in the system, a continuous flow of water will thus be produced at the drill point. This play should not be excessive, as is the case in the known drills operated hydraulically in which some or all the exhaust water is used for washing out the bore hole, only a very slight flow being allowed, so as not to interfere with the working of the instrument.

In the form of the invention shown in Figures 4 and 5, a generator is arranged to drive two drills, 30, 31, mounted on suitable tripods 32, at a distance, for example, of 500 feet, the connection being made by a liquid column in 1 inch steam pipe.

The water is supplied from the tank 33, and is pumped by the pump 34 to the pressure tank 35, in which a constant pressure of about 140 lbs. is maintained by an air cushion 36, and suitable back flow 37 back to the tank 33. The spring 38 of the back flow valve is adjusted to maintain a suitable pressure in the tank 35. A non-return valve 39 is provided between the constant pressure tank 35 and the pipe line 40 leading to the drills. A capacity 41 is provided, as described in Application for Letters Patent No. 4349 of even date herewith. The capacity 41 is connected to suitable drills by the pipes 42, 43. These pipes may be provided with condensers or inertia devices, as may be necessary to keep the pressure within reasonable limits, the number of these depending on the length of the line 42, 43, as explained in the Specification of Letters Patent No. 12,438 of 1914. In the example illustrated with no condenser between the pump and the drill satisfactory working is obtained at a periodicity of 500 per minute.

The drills 30, 31, may be of the type above described, and illustrated in the accompanying drawings, and may be mounted on suitable tripods, and provided with ordinary feeding devices, for example, a hand wheel and screw 44.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1.—A rock drill or like reciprocating apparatus, operated at a distance from

a power generator by means of a series of periodic variations of pressure and volume travelling along a single liquid column.

2.—A rock drill or like reciprocating apparatus, as claimed in Claim 1, having springs co-operating with the reciprocating part in such a manner as to form a condenser adapted to counteract inertia effects at the period of reciprocation employed.

3.—In combination with a rock drill, operated as claimed in Claim 1, a condenser arranged to permit a flow of liquid through it.

4.—A rock drill operated by periodic variations of pressure and volume travelling along a liquid column, as claimed in Claim 1, and having a leak or spray supplied with liquid from the liquid column.

5.—The improved drilling plant operated by periodic changes of pressure and volume in a liquid column as hereinbefore described and illustrated in the accompanying drawings.

Dated this 19th day of March, 1915.

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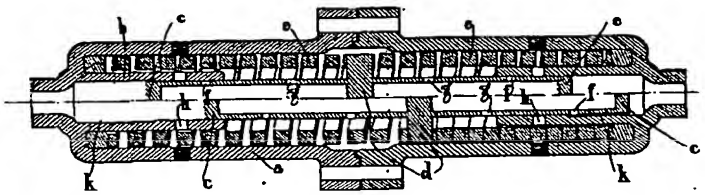
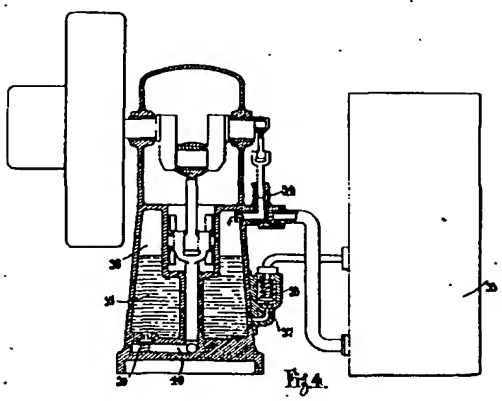


Fig.1.



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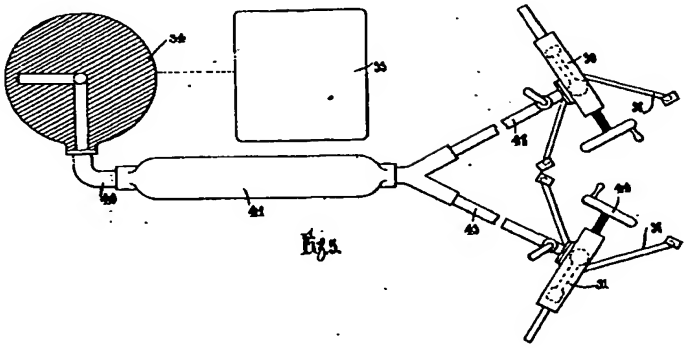

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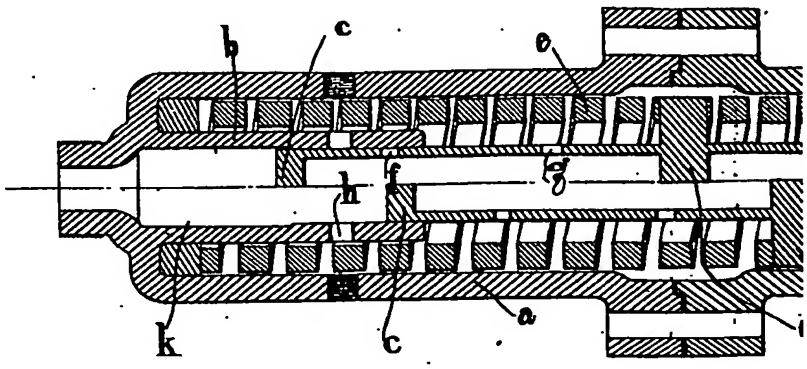


Fig.1.

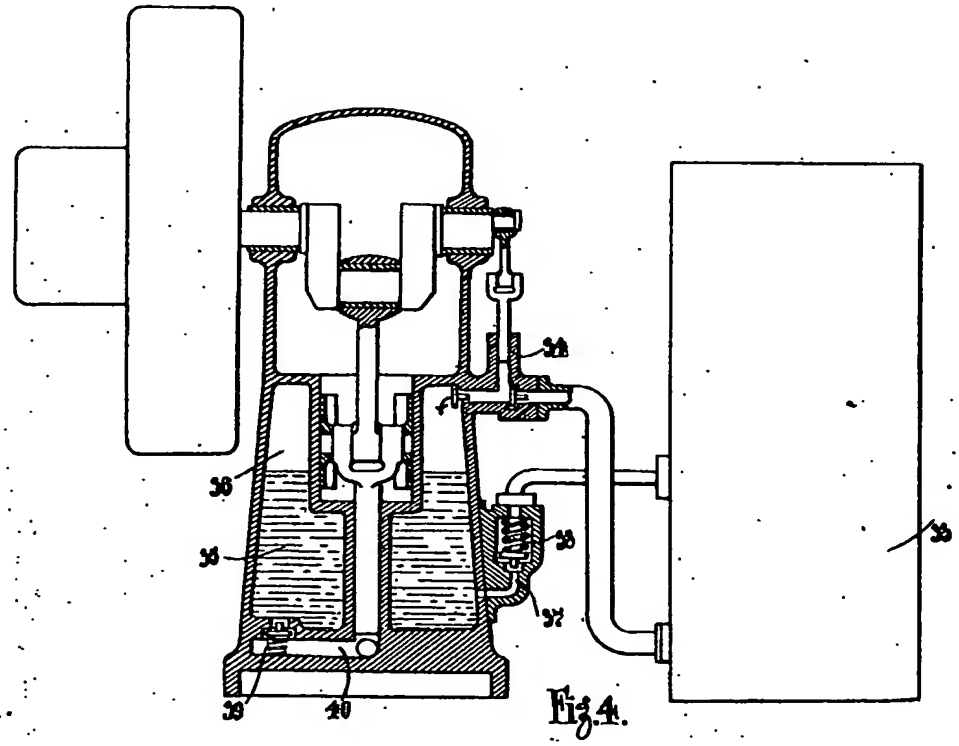
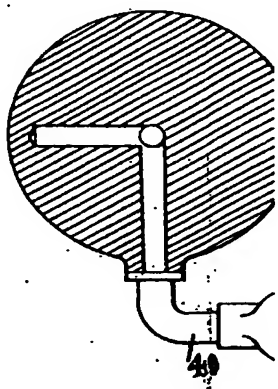
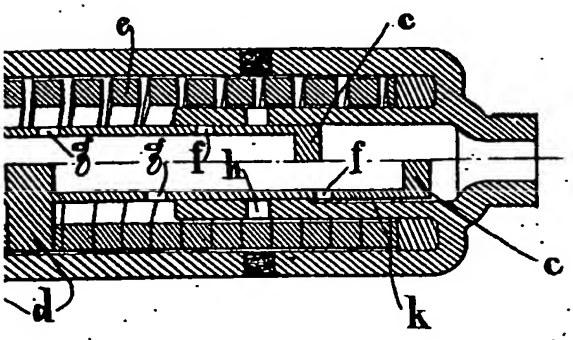


Fig.4.





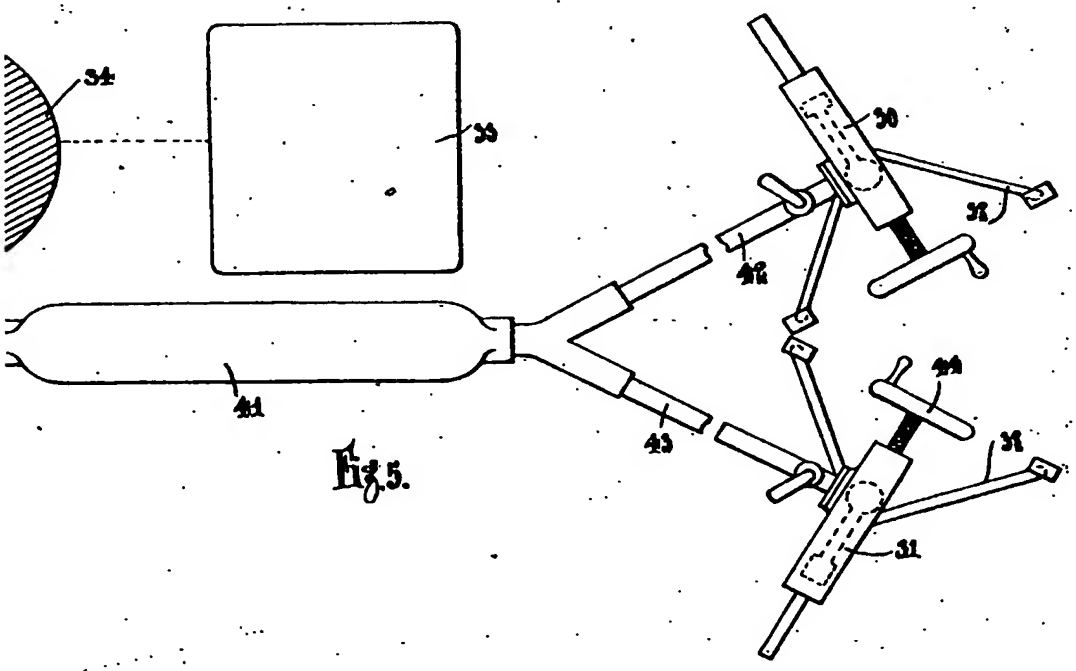


Fig.5.

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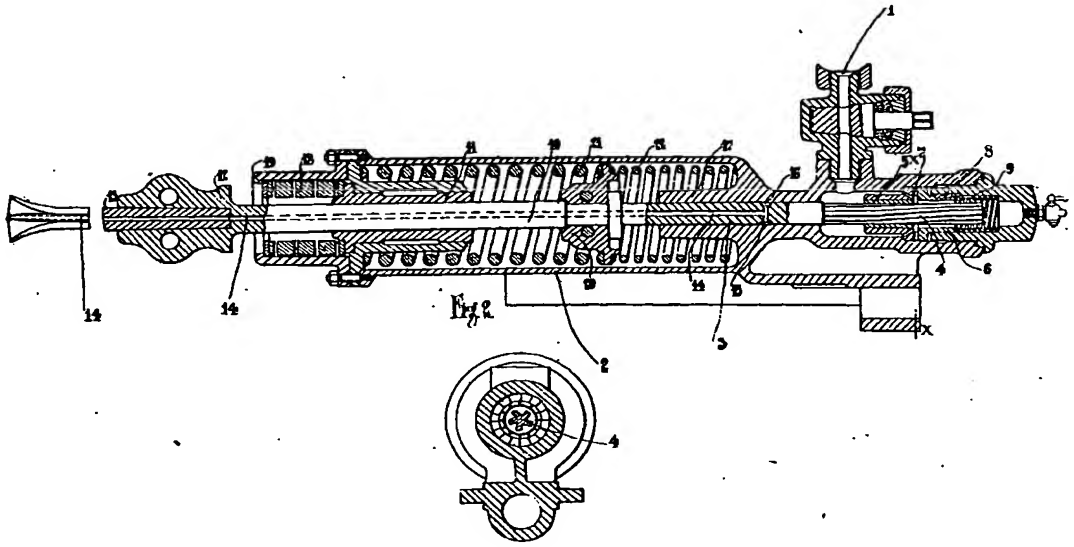

Fig 2.

Fig 3.

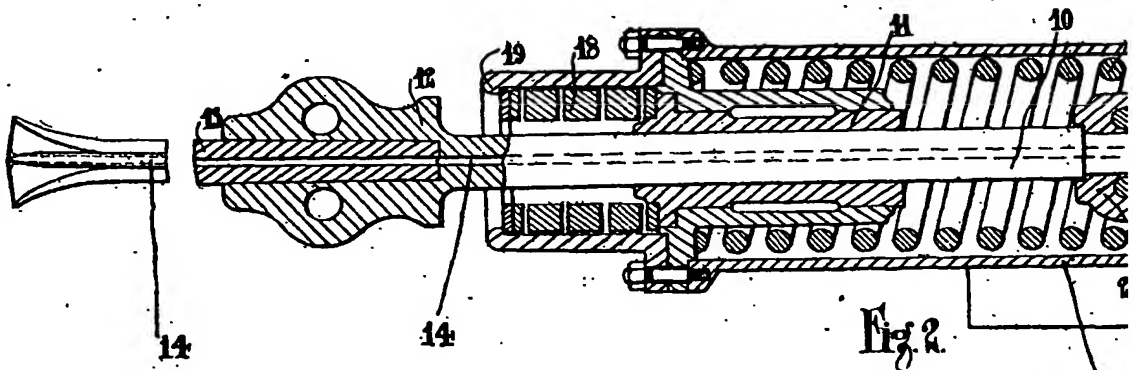

Fig. 2.

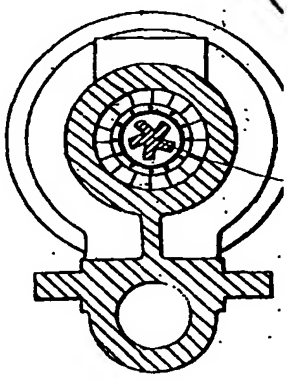

Fig. 3.

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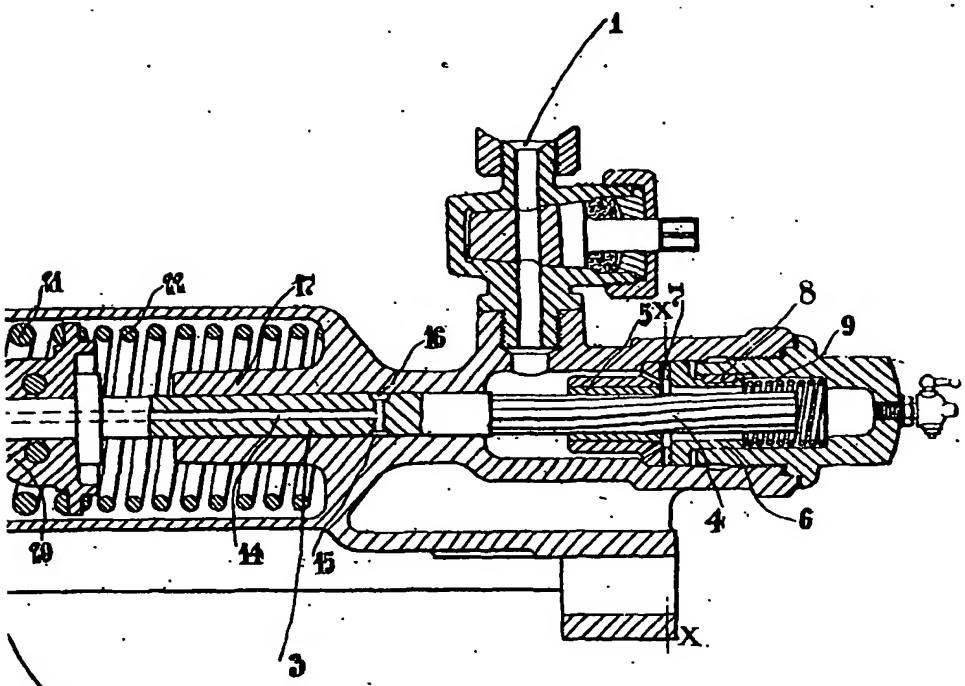
SHEET 2.



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AMENDED SPECIFICATION.

Reprinted as amended in accordance with the decision of the Chief Examiner, dated the 27th day of July, 1917.

(The Amendments are shown in erased and italic type.)

N° 4350* A.D. 1915

Date of Application, 19th Mar., 1915—Accepted, 16th Mar., 1916

COMPLETE SPECIFICATION (AMENDED).

Improvements in Rock Drills and like Machines.

We, GOGU CONSTANTINESCO, Engineer, of "Underwood", 8, Lichfield Road, Kew Gardens, London, W., and WALTER HADDON, Engineer, of 132, Salisbury Square, Fleet Street, London, E.C., do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to the application of methods of energy transmission by wave motion through liquids as described in the Specifications of Letters Patent No. 9029 of 1913 and No. 12,438 of 1914 to machines such as rock drills or analogous reciprocating machines.

In the said specifications reciprocating devices are shown which are operated by wave motion through liquids contained in two or more liquid columns connecting the generator with the machine operated.

The invention consists in a rock drill or like reciprocating apparatus operated at a distance from a power generator, by means of a series of periodic variations of pressure and volume travelling along a single liquid column.

The invention also consists in a rock drill or like reciprocating apparatus having springs co-operating with the reciprocating part, in such a manner as to form a condenser, adapted to counteract inertia effects at the period of reciprocation employed.

~~The invention further consists in combining with a rock drill operated as above described a condenser arranged to permit of a flow of liquid through it.~~

The invention also consists in the improved applications of transmission of power through liquid columns by wave motion hereinafter described.

The apparatus required according to this invention comprises a suitable prime mover, driving a pump, a single line of pipe connecting the pump to a drill constructed as hereinafter described, and if desired, a capacity consisting of a large vessel filled with liquid in connection with the pipe. For instance, in a plant adapted to drill a two-inch hole in hard rock, at the rate of about two inches a minute, there may be employed an electromotor of five horse-power, driving by a belt a pump having a piston of diameter 1½ inches and a stroke of 2½ inches. A bye-pass is provided by which the pump can be run up to speed without being placed in connection with the pipe leading to the drill. In proximity with the pump, there may be provided a large vessel with rigid walls, and of a capacity of 640 cubic inches, a suitable cock being provided by which the capacity can be cut off from the line as desired. The connection with

[*Price* 6*d*.]

the drill is made through one-inch wrought iron steam pipe, a length of 560 feet being used between the pump and the drill. The drill itself may be constructed as hereinafter described and illustrated.

The operation of such a plant is as follows:—The motor is started up, and the pump run up to speed pumping through the bye-pass, the speed of the motor being regulated to a given value, so that a given number of reciprocations of the pump takes place per minute. In the plant hereinafter described, 500 reciprocations per minute are employed, and the initial pressure of the liquid (which may be water) in the pump and the line may be 140 lbs. per square inch. The cock connecting the capacity to the line is now opened, and the bye-pass cock of the pump closed. The result is that the impulses given by the pump are communicated to the capacity and to the line, and each particle of liquid in the line will be set in reciprocating motion about a mean position. The whole mass of liquid in the line, however, will not reciprocate as a whole, but a series of periodic changes of pressure and volume will travel along the pipe. The liquid in the neighbourhood of the piston is alternately compressed and expanded, and the changes of pressure and volume travel along the line with substantially the velocity of sound in such a liquid column.

It will be seen that the working of the apparatus thus depends on the compressibility and elasticity of the liquid in the column, and that the power is transmitted by a true wave motion. In the particular instance under consideration the wave length would be about 500 feet. In the example given, the length of the wave is substantially the distance between the pump and the drill. Other distances, however, may be employed, suitable condensers, as described in the Specification of Letters Patent No. 12,438 of 1914, being employed to counteract the inertia of any length of the pipe beyond a multiple of the wave length.

A part of the apparatus hereinafter described comprises a condenser adapted to allow a limited flow of water through it, and the drills are constructed with apertures allowing the water to pass through them, so as to provide a stream for washing out the boring. This leak, however, has no function in the driving of the drill. When the impulses have been turned on to the line, as above described, in order to start the drill, it is merely necessary to turn the cock, admitting the pulsations to the end of the drill piston. The length of stroke of the drill will vary according to the extent to which this cock is opened.

Referring to the accompanying drawings—

Figure 1 shows a condenser arranged to allow for a continuous flow of liquid between the generator and receiver.

Figure 2 shows a combined condenser and rock drill.

Figure 3 is a section on the line X—X of Figure 2.

Figures 4 and 5 show a generator arranged to drive two drills mounted on suitable stands.

In the condenser illustrated in Figure 1, the condenser chamber *a* is provided at the two ends with an internally projecting cylindrical portion *b*, *b*, in which the ends of a hollow piston *c* slide. The hollow piston is closed at the two ends, and carries in the middle the projecting flange *d*, which allows clearance between its circumference and the walls of the chamber *a*. This flange serves as the abutment for the springs *e*, *e*, which normally keep the piston in the mean position, as shown in the top half of Figure 1. The lower half of Figure 1 shows the position at one end of the stroke. Ports *f*, *g*, are provided at the two ends of the hollow piston, and ports *h*, *h*, are provided through the internally projecting sleeves *b*. This sleeve is of a diameter larger than will fit the piston at its ends, as shown at *k*, *k*, and it will be seen that when the piston is at the end of its stroke, as illustrated in the lower half of Figure 1, there is a free passage through the condenser from the right hand side round the annulus between the piston and the enlarged portion of the chamber *k*, through the ports *f* and *g*, and around the flange *d*, through the

port *h* at the left hand end, and so out through the other end of the chamber. It will be seen therefore that in this arrangement, at the end of the stroke in each direction there is free passage for liquid through the condenser. *Devices of this kind however form no part of the present invention but are claimed in our Letters Patent No. 15,526 of 1915.*

Instead of providing special means for allowing a leak at the ends of the stroke, as above described, the pistons may be made a loose fit in the condenser chamber, so that there is a constant leakage from one end to the other.

In the rock drill illustrated in Figures 2 and 3, the fluid is admitted at 1, causing pulsations to take place in the cylinder 2. The working piston 3 is integral with the rifled extension 4, working in a ratchet device 5, 6. The member 5 carries a rifled bush, and suitable teeth 7, engaging with similar teeth in the member 6. The member 6 is free to move longitudinally in the direction of the axis of the piston, but is prevented from revolving by longitudinal sliding keys 8. A spring 9 presses the part of the ratchet 6 against the part 5. When the rifled extension 4 moves longitudinally, it rotates the ratchet 5, but the form of the teeth 7 is such that in one direction they hold together, but not in the other. In this way on the down stroke of the piston the teeth slip, and the piston does not rotate; while on the up stroke of the piston they bind together, and the piston rotates. The piston rod is thus rotated slowly in one direction, in order to turn the cutting bit. The piston 3 is integral with the rod 10, sliding in the bush 11, which carries the chuck 12, holding the drill bit 13. The piston rod 10 and the drill bit are perforated in the centre by a passage 14 ending in a cross passage 15, communicating with an annular chamber 16 around the piston 3. In the forward end of the drill body 17 a stiff spring 18 is provided, held between the flange 19 and the bush 11. The bush 11 is free to slide longitudinally against the spring 18. The piston rod 10 carries a strong flange 20, supported by two springs 21, 22, forming a condenser with the piston working the drill, the spring 21 being stronger than the spring 22, in order to provide for the return stroke of the piston when working.

The operation of the instrument is as follows:—

The pulsations of the liquid entering by the cock 1 transmit motion to the piston rod and drill bits, the inertia of these parts being conveniently balanced by the condenser formed by the springs 21, 22, and the piston 10, in the manner explained in the Specification of Letters Patent No. 12,438 of 1914. The cutting of the rock is effected by the percussive movement applied to the bit 13, and the rotation is effected by the ratchet 5, 6, as above described. A leakage occurs between the piston 3 and the cylinder walls 17, and through the annular space 16 and the passage 14 to the end of the drill bit. If water is used in the system, a continuous flow of water will thus be produced at the drill point. This play should not be excessive, as is the case in the known drills operated hydraulically in which some or all the exhaust water is used for washing out the bore hole, only a very slight flow being allowed, so as not to interfere with the working of the instrument.

In the form of the invention shown in Figures 4 and 5, a generator is arranged to drive two drills, 30, 31, mounted on suitable tripods 32, at a distance, for example, of 500 feet, the connection being made by a liquid column in 1 inch steam pipe.

The water is supplied from the tank 33, and is pumped by the pump 34 to the pressure tank 35, in which a constant pressure of about 140 lbs. is maintained by an air cushion 36, and suitable back flow 37 back to the tank 33. The spring 38 of the back flow valve is adjusted to maintain a suitable pressure in the tank 35. A non-return valve 39 is provided between the constant pressure tank 35 and the pipe line 40 leading to the drills. A capacity 41 is provided, as described in Application for Letters Patent No. 4349 of even date herewith. The capacity 41 is connected to suitable drills by the pipes 42, 43. These

pipes may be provided with condensers or inertia devices, as may be necessary to keep the pressure within reasonable limits, the number of these depending on the length of the line 42, 43, as explained in the Specification of Letters Patent No. 12,438 of 1914. In the example illustrated with no condenser between the pump and the drill satisfactory working is obtained at a periodicity of 500 per minute.

The drills 30, 31, may be of the type above described, and illustrated in the accompanying drawings, and may be mounted on suitable tripods, and provided with ordinary feeding devices, for example, a hand wheel and screw 44.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1.—A rock drill or like reciprocating apparatus, operated at a distance from a power generator by means of a series of periodic variations of pressure and volume travelling along a single liquid column.

2.—A rock drill or like reciprocating apparatus, as claimed in Claim 1, having springs co-operating with the reciprocating part in such a manner as to form a condenser adapted to counteract inertia effects at the period of reciprocation employed.

~~3.—In combination with a rock drill, operated as claimed in Claim 1, a condenser arranged to permit a flow of liquid through it.~~

3 4.—A rock drill operated by periodic variations of pressure and volume travelling along a liquid column, as claimed in Claim 1, and having a leak or spray supplied with liquid from the liquid column.

4 5.—The improved drilling plant operated by periodic changes of pressure and volume in a liquid column as hereinbefore described and illustrated in *Figures 2, 3, 4 and 5 of* the accompanying drawings.

Dated this 19th day of March, 1915.

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A.D. 1915. March 19, No. 4350.*
CONSTANTINESCO & another's Amended Specification

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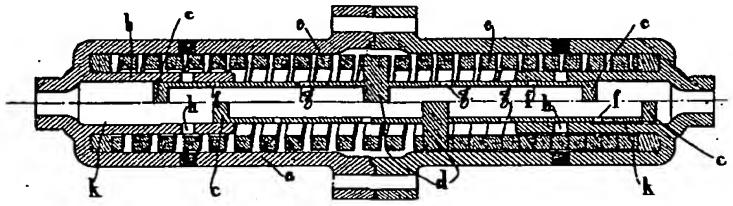


Fig.1.

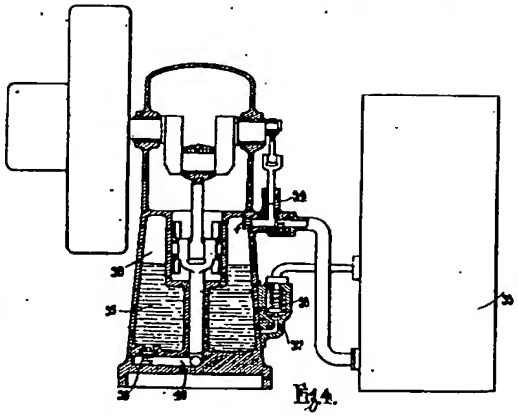


Fig.4.

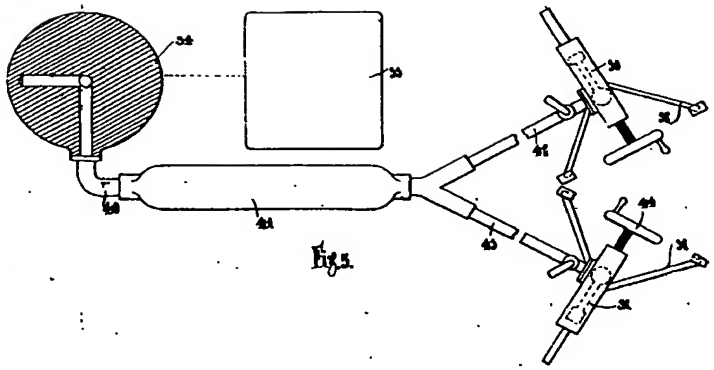


Fig.5.

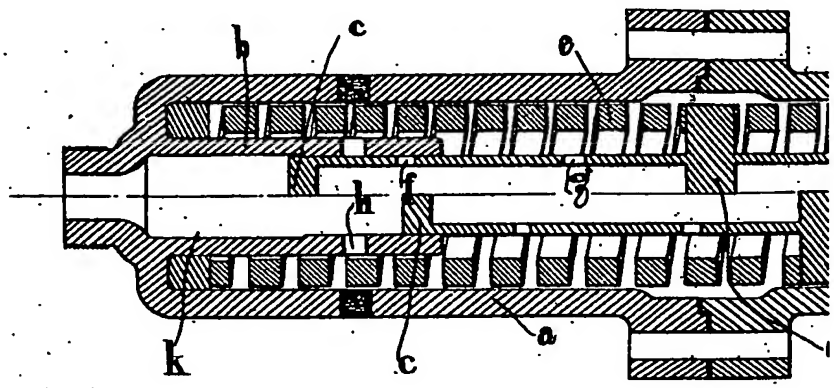


Fig.1.

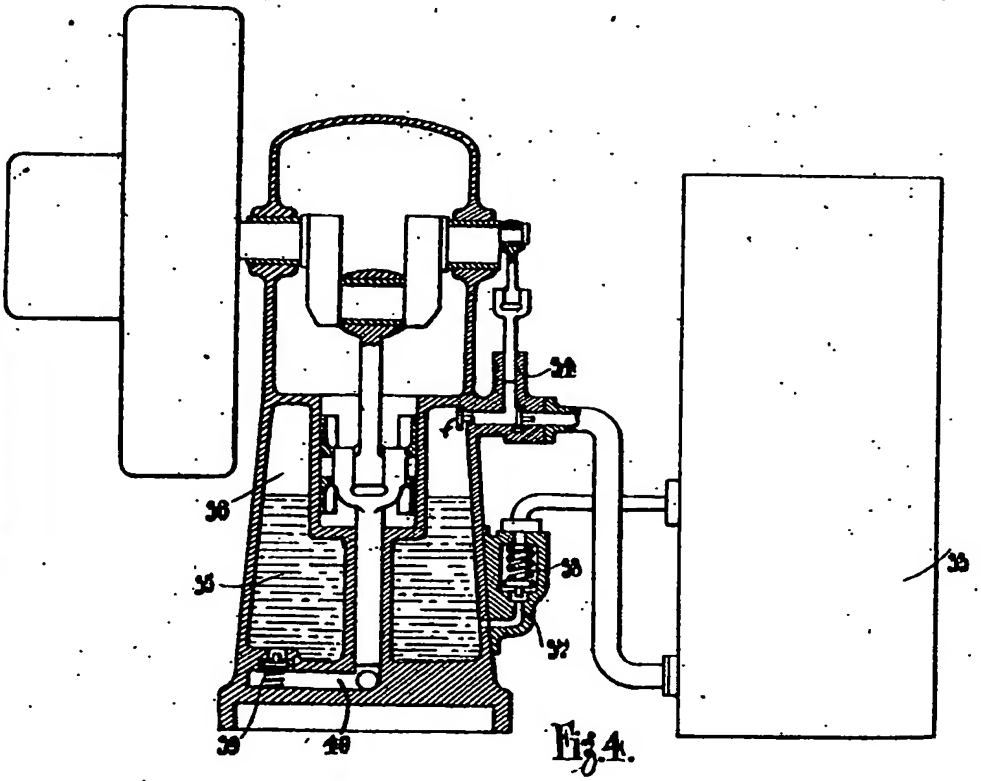
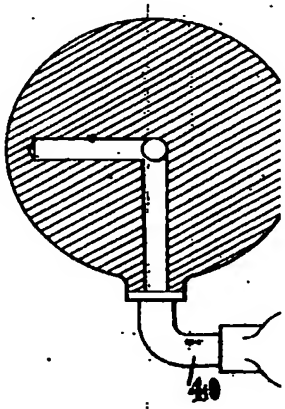
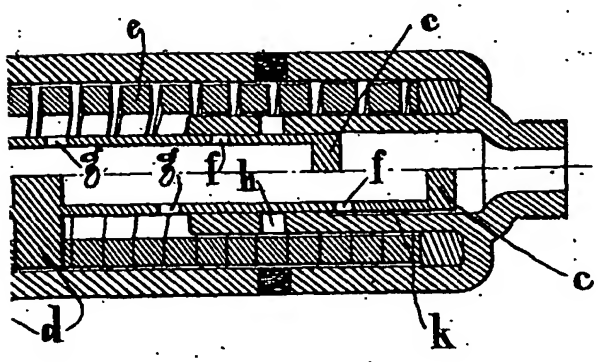


Fig.4.





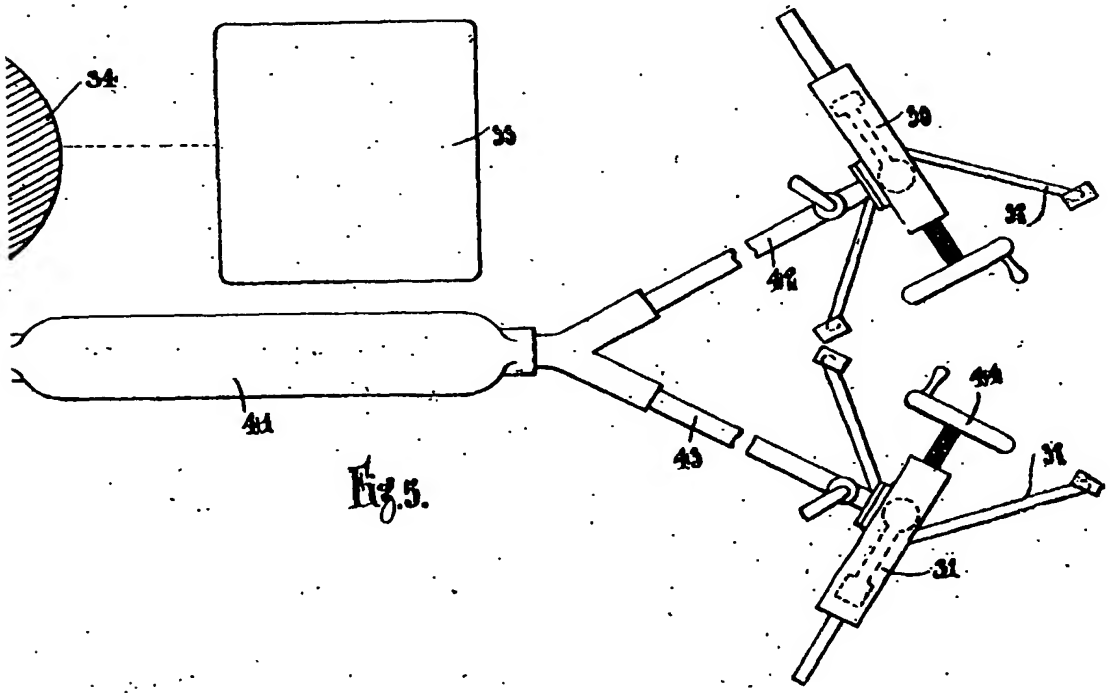


Fig. 5.

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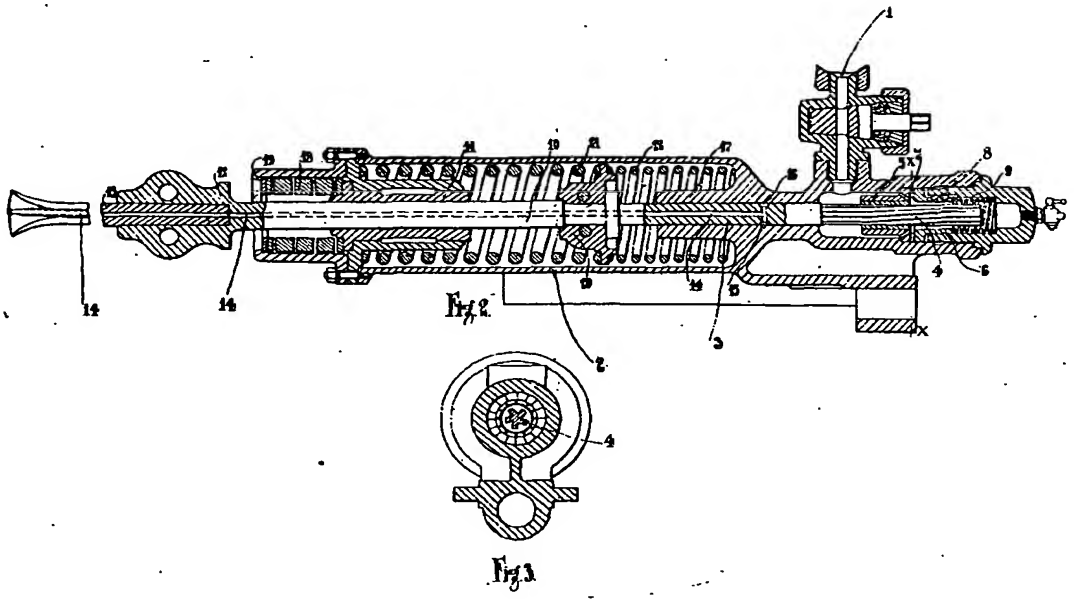


Fig. 2.

Fig. 3.

[This Drawing is a full-size reproduction of the Original.]

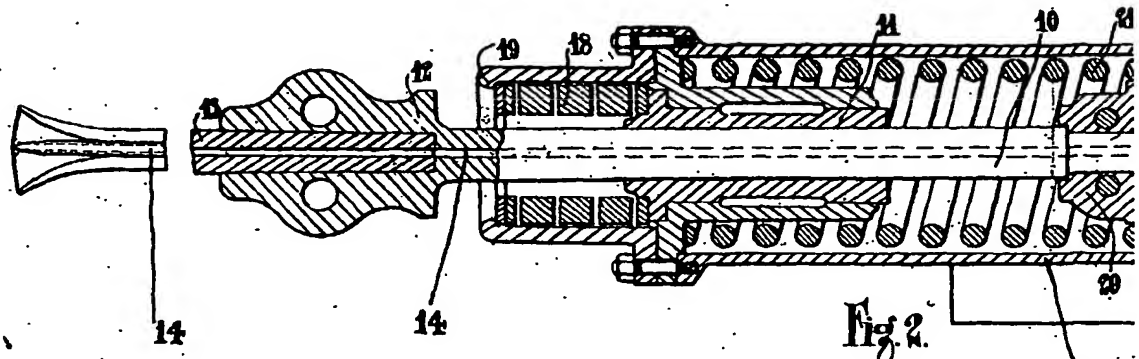


Fig. 2.

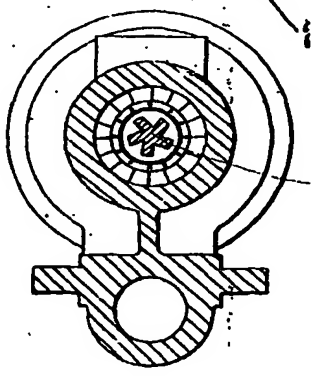
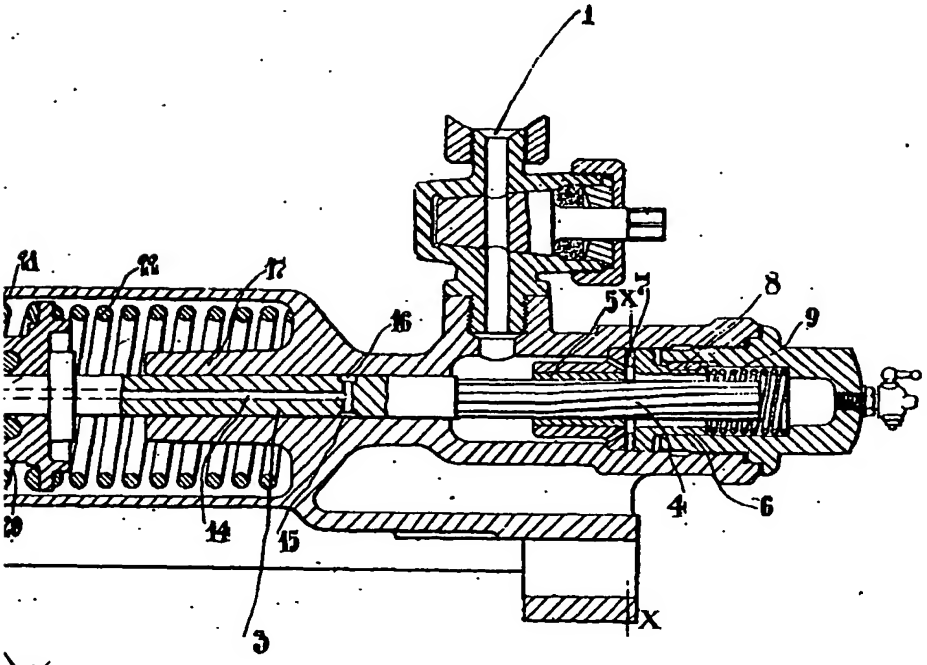


Fig. 3.



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